

Unit 7 – Radioactivity (Ch. 10 & 11)

Chapter 10.1 – Radioactivity and Its History

1. The cathode ray tube was a major invention involved in discovering _____. Cathode rays behave like _____ particles which are known as _____.
2. German physicist, _____ discovered _____ where the _____ stood for “unknown.”
3. _____ and her husband _____, with the help of the work of the French physicist, _____, made huge advances in nuclear chemistry with their studies concerning radioactivity.
4. List the different types of waves/rays in the electromagnetic spectrum from lowest frequency/energy to highest frequency/energy.
5. _____ is the one form of radiation that humans can actually see.
6. The term _____ was coined by Marie Curie for the spontaneous _____ of radiation from the _____ of an atom.

Chapter 10.2 – Radioactivity and the Nucleus

1. Describe Ernest Rutherford's experiment in which he used radioactivity to explore an atom. What did he conclude from the experiment?
2. Rutherford discovered that a hydrogen nucleus was a subatomic particle and named it a _____. Years later James Chadwick discovered that atomic nuclei contained neutral particles that he called _____. These particles are not stable outside of a _____.

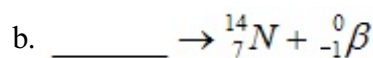
3. The atomic number of an element is the same as the number of _____. The mass number of an element represents the number of _____ and _____ added together.
4. _____ is the term given to different atoms of a particular element that have the same number of _____, but different numbers of _____.
5. Describe how you can find how many neutrons are in a certain isotope of an element if the atomic number is 52 and the mass number is 134.
6. Describe the element, atomic number, number of protons, mass number, and number of neutrons for the following standard atomic notation: ${}_{19}^{41}\text{K}$
7. What do all isotopes of the same element have in common?
8. How do isotopes of the same element differ?
9. Complete the following table:

Isotope	Atomic Number	# Protons	Mass Number	# Neutrons
Carbon-13	6		13	
Cobalt-27		27		32
	11		23	
Arsenic-33			75	
		17	37	

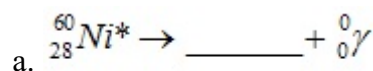
Chapter 10.3 – Radioactive Decay

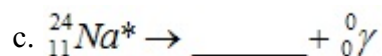
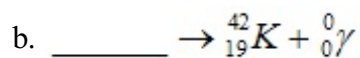
1. Radioactive atoms emit _____ because their nuclei are _____.
2. The process in which unstable nuclei lose energy (thus gaining stability) by emitting radiation is known as _____.
3. When one element changes into another we call this _____. During this process, a _____ nucleus changes into a _____ nucleus.
4. The three main types of emitted radiation are _____ radiation, _____ radiation, and _____ radiation.
5. Alpha radiation is a stream of _____ that have the same combination of particles as the nucleus of a _____ atom, with a mass number of ____ and an atomic number of ____.
6. Alpha particles are made up of _____ protons and _____ neutrons.
7. Alpha particles are much larger than other types of radiation making them relatively _____ and not highly _____.
8. The term used to describe the emission of an alpha particle from a nucleus is _____.
9. Complete the following alpha decay problems:
 - a. ${}^{208}_{84}\text{Po} \rightarrow \text{_____} + {}^4_2\alpha$
 - b. ${}^{225}_{89}\text{Ac} \rightarrow \text{_____} + {}^4_2\text{He}$
 - c. $\text{_____} \rightarrow {}^{192}_{77}\text{Ir} + {}^4_2\alpha$
10. A _____ is an electron. Electrons have a negligible mass that is approximately 0.0005 the mass of a proton or neutron, therefore electrons are assigned a mass of _____.
11. Beta particles (electrons) have a charge of _____.

12. During beta decay a neutron changes into a _____ and an _____. During this process the _____ stays in the nucleus while the _____ shoots out from the nucleus with a significant amount of energy.
13. Since the only thing emitted during beta decay is an electron, the _____ remains unchanged and the _____ increases by one.
14. A well-known beta decay reaction involves the _____ isotope used in the treatment of cancer of the thyroid gland.
15. Complete the following beta decay problems:



16. Gamma radiation consists of high _____ rays with a short _____.
17. Gamma radiation has almost no _____ and no _____, therefore during beta decay both the atomic number and mass number remain unchanged.
18. Due to its insignificant size, _____ has the greatest _____ of the three major types of radiation.
19. In gamma decay reactions equations we use the symbol (*) to represent that a certain nucleus has extra _____.
20. Complete the following gamma decay problems:





21. The symbol α is used to represent an _____ particle, the symbol β is used to represent _____ particle and the symbol γ is used to represent a _____ particle.
22. Alpha particles can also be represented by a _____ nucleus, and beta particles can also be represented by an _____.
23. In nuclear reaction equations, the _____ protons plus neutrons, and the charge number remain _____.
24. What are two devices we use to detect radiation?

Chapter 10.4 – Half-Life

1. A half-life is a constant for any radioactive isotope and is equal to the time required for _____ the _____ in a sample to decay. Half-lives are different for different _____.
2. The isotope that undergoes radioactive decay is called the _____ and the stable product of radioactive decay is called the _____.
3. We use radioactive isotopes in _____. The radioactive isotope _____ for example, is injected into a patient's bloodstream and travels to the patient's heart. This allows us to obtain an _____ of the heart.
4. An _____ is a curved line on a graph that shows the _____ at which radioactive isotopes decay.

5. If the half-life for an isotope is 35 days, how much of a 10g sample would remain after:
- a. 35 days?
 - b. 70 days?
 - c. 105 days?
6. Explain how you would determine how much of a 50g sample of iodine-131 would remain if iodine-131 has a half-life of 8 days and 32 days have passed since the sample was made.
7. What is a decay series?
8. Uranium-_____ forms a decay series that ends with the stable isotope lead-_____.
9. Carbon dating (also known as _____) is the process of determining the age of an object by measuring the amount of _____ remaining in that object.
10. Describe the process of carbon dating. How old can an object be to be used for carbon dating?
11. The daughter isotope for carbon-14 is _____.

Chapter 11.1 – Nuclear Reactions

1. Particle accelerators accelerate charged particles to _____ speeds and then smash the particles into target _____. The two types of particle accelerators are _____ and _____.
2. Scientists can use accelerators to study _____ particles. Nuclear scientists can also create elements that do not _____ occur using a process known as _____ radioactivity.
3. In artificial radioactivity, scientists can change a _____, stable isotope into a radioactive isotope by _____ the isotope with an alpha particle or a _____.
4. Explain the concept of artificial radioactivity using the example of Aluminum-27 being bombarded with alpha particles.
5. Artificial isotopes can be useful in treating cancerous _____.
6. _____ is the term for the radiation we come into contact everyday that is all around us. Generally, since this type of radiation is always around us it is viewed as _____.
7. What are the four ways to minimize the effects of radiation on your body?
8. The intensity of radiation decreases the _____ you are from the radioactive source.
9. Explain the relevance of Einstein's equation $E=mc^2$ in terms of nuclear reactions.

Chapter 11.2 – Nuclear Reactions: Fission

1. Nuclear fission involves the _____ of a larger nucleus into two smaller nuclei, subatomic particles and energy. The fission of a nucleus is accompanied by a _____ release of energy.
2. Larger, heavier nuclei tend to be _____, and in order to increase stability atoms with heavy nuclei split into lighter atoms.
3. Describe the process of the induced uranium-235 nuclear fission reaction that occurs in both fission-style nuclear weapons and in Canadian nuclear power plants. Be sure to include the production the unstable uranium-236 isotope in your explanation as well as all the reactants and products of the reaction.
4. Uranium -235 and uranium-238 occur in natural _____ containing uranium. Separating the two can be done because they differ in _____. However, this process is quite _____ and _____.
5. There is a tremendous amount of _____ released from a nuclear fission reaction. This energy is released because some _____ is converted to energy in the reaction.
6. What is critical mass? What happens when it is reached?
7. What are the two methods used in nuclear fission weapons to initiate the nuclear reactions?

Chapter 11.3 – Nuclear Power Generation

1. The term used to describe the ongoing process in which one reaction initiates more reactions is a _____. These types of reactions can produce rapidly increasing amounts of _____ and may lead to violent _____.
2. Why is the release of neutrons, krypton-92 and barium-141 in induced uranium-235 reactions important?
3. What were the five major problems that had to be addressed during the development of the nuclear fission reactor? How was each problem addressed?
4. Chain reactions can be controlled using _____ to absorb neutrons.
5. Explain the concern of chain reactions in nuclear power plants.

6. What does CANDU stand for? How does it work? Why is Canada a modern leader in the nuclear technology of the world?
7. The most common nuclear fission reactor in the world is a _____ (PWR). This type of reactor uses water for the moderator and coolant.
8. What are some advantages and disadvantages of nuclear power?

Chapter 11.5 – Nuclear Reactions: Fusion

1. Nuclear fusion is the process in which _____ low mass nuclei join together to form a more _____ nucleus. This type of reaction occurs on the _____, as well as on other _____.
2. Fusion reactions require a tremendous amount of _____ and _____ to occur.
3. Describe the fusion reaction that occurs in the Sun.
4. What is the fusion reaction that occurs in a hydrogen bomb?
5. A neutrino is a particle that has _____ but no _____ or _____.
6. Even though we have not yet built a nuclear fusion reactor, a major advantage would be that it would produce energy and no harmful _____ products. However the tremendous temperatures and _____ needed make it very difficult to create. They currently require more _____ than they create.

7. What do fission and fusion reactions have in common?
8. How do fission and fusion reactions differ? Be sure to consider the reactions, the products, and human usage.

Vocabulary to Know

Write a concise definition of each of these terms found in this chapter.

Alpha particle -

Beta particle -

CANDU -

Chain reaction -

Daughter isotope -

Decay series -

Fission-

Fusion-

Gamma particle -

Half-life -

Isotopes -

Mass number -

Nuclear equation -

Nuclear reaction -

Parent isotope -

Radiation -

Radioactive decay -

Radiocarbon dating -